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OUTLINES OF PHYSIOLOGY

BY

T. B. WIGGIN, M. D.

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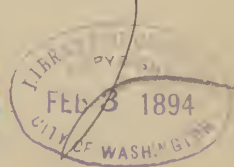
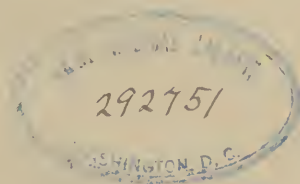
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OUTLINES OF PHYSIOLOGY

BY
T. B. WIGGIN, M. D.

PROFESSOR OF PHYSIOLOGY,
AMERICAN COLLEGE OF DENTAL SURGERY.



CHICAGO.

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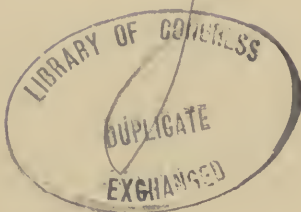
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OUTLINES OF PHYSIOLOGY.

1. Define Physiology.

A. Physiology is the science that treats of the functions of the body. It tells how man is begotten, born, lives, moves and has his being ; how he attains maturity and how he dies.

2. What are the essentials of life ?

A. Birth, Growth, Development, Decline, Decay and Death.

3. Define each.

A. BIRTH—Separation from the parent with power to maintain existence.

GROWTH—Inherent power to increase in size.

DEVELOPMENT—Gradual advance, stage by stage, of animal or vegetable bodies from the embryonic to the perfect state. A specialization of function.

DECLINE—State in which waste exceeds repair.

DECAY—State in which the vital forces become impaired.

DEATH—The cessation of life.

4. Define Embryology.

A. The science which treats of the growth and structure of organisms from their first coming into being.

5. What is Protoplasm ?

A. A Viscid albuminoid substance, homogeneous in structure, alkaline in reaction, the physical basis of all life.

6. Define a Cell.

A. A nucleated mass of protoplasm of microscopic size with sufficient individuality to have a life history of its own.

7. What changes do cells undergo ?

A. Birth, Growth, Development, Decline, Decay and Death.

8. What characteristics do cells have ?

A. The power of spontaneous movement.

Irritability, or the power of response to stimuli.

Nutritive powers.

Reproductive powers.

9. What is the unit of Physiology ?

A. Protoplasm.

10. Upon what does all life depend ?

A. A cell.

11. Give fair example of a simple cell as seen in Nature.

A. An amœbae, a monocular organism.

12. Define an inorganic body.

A. One that does not depend upon organization for existence.

13. Define an organic body.

A. One that depends upon an organization for life.

14. State difference in growth of organic and inorganic bodies.

A. An organic body's growth is interstitial or from within out. Inorganic bodies grow by addition to their outer surfaces, or from without in.

15. What is the effect of the performance of function in living matter ?

A. Every action, or effort during life wears out the tissues, whether voluntary or involuntary, consequently there is constant waste, and equally constant effort to repair that waste.

16. Does the length of life of individual cells in different sized organic bodies vary?

A. It does. The processes of life are relatively more rapid in small animals, so the smaller the animal the shorter the life of the cells of which it is composed, and vice versa.

17. How are cells reproduced?

A. By gemmation or budding in low forms of life. By fission or division in higher animals.

18. How do cells die, and give examples.

- A.*
1. By mechanical abrasion—cells of skin.
 2. By chemical transformation the muscle cells of uterus after birth of foetus undergo fatty degeneration.

19. Give some differences between plants and animals.

- A.*
1. Power of movement in animals, none in plants.
 2. Digestive tract in animals, none in plants.

20. Why do animal cells require different food from vegetable cells?

A. Vegetable cells build up new protoplasm from organic salts from the air and from water by virtue of the chlorophyl or green coloring matter which they possess. Animal cells must have protoplasm ready formed, having no chlorophyl.

21. How are cells of the body described?

- A.*
1. SHAPE—Cylindrical, conical, prismatic.
 2. SITUATION—Blood, glandular and connective tissue cells.
 3. CONTENTS—Fat and pigment cells.
 4. FUNCTION—Protective, secreting, contractile cells.
 5. ORIGIN—Mesoblastic, hypoblastic, epiblastic cells.

22. What is the first trace of the differentiation of Protoplasm?

A. Appearance of a nucleus.

23. What two important characteristics do nuclei possess differing from protoplasm?

A. 1. Power of staining.

2. Resistance to acids and alkalies.

24. How are cells connected to form tissues?

A. 1. By intercellular cement substance.

2. By anastomosis of their processes.

25. What is a primary tissue element?

A. The cell.

26. What are derived tissue elements?

A. 1. Intercellular substances.

2. Fibres.

3. Tubules.

27. Where is epithelium found?

A. It covers the entire body and lines all open and closed cavities.

28. How is epithelial tissue classified?

A. 1. Simple. 2. Transitional. 3. Stratified.

29. Name four varieties of simple epithelial cells.

A. 1. Squamous. 2. Spheroidal or glandular. 3. Columnar. 4. Ciliated.

30. What is Endothelium?

A. A term applied to epithelial tissues lining closed cavities.

31. What are the functions of epithelium?

A. 1. Protective. 2. Protective and moving. 3. Secreting. 4. Protective and secreting. 5. Sensorial.

32. Give an example of the location of each kind.

A. 1. Protective—Skin. 2. Protective and moving—Ciliated Epithelium lining respiratory tract. 3. Secreting—Glandular epithelium. 4. Protective and secreting—Lining intestines. 5. Sensorial—Rods and cones of retina.

33. What purpose do connective tissues fulfill?

A. Forms the skeleton with its connections. A supporting framework and covering to the organs composed of muscular, glandular and nerve tissues. The chief function, a mechanical one of support.

34. Name the different connective tissues.

A. 1. Fibrous connective tissues. 2. Cartilage. 3. Bone.

35. From what two elements are connective tissues made up?

A. 1. Cells. 2. Intercellular substance.

36. Give an example of yellow elastic tissue.

A. The true vocal cords.

37. What is Areolar tissue?

A. The sub-cutaneous, sub-serous, sub-neucous tissue of the body. It sheaths muscles, nerves, glands, and all internal organs, penetrating their interior, supporting and connecting their finest parts, and is the most common of all connective tissues.

38. Name the special forms of connective tissue.

A. 1. Adenoid or Reteform. 3. Adipose.
2. Gelatinous. 4. Neuroglia.

39. What is Cartilage composed of and into what classes is it divided?

A. Cells imbedded in the matrix. 1. Hyaline.
2. Yellow Elastic. 3. White Fibro Cartilage.

40. Name the composition of bone and give its use?

A. 67 per cent. earthly and 33 per cent. animal matter. Bones form the framework of the body, protect delicate internal organs, and act as levers moved by muscles attached to them.

41. What is the blood?

A. The principal circulating fluid of the body, red, viscid and containing nutrient materials for its support.

42. What is the reaction of the blood and upon what does it depend?

A. Alkaline. It depends upon the sodium phosphate which it contains.

43. Give color of blood and name coloring matter.

A. Red. Hæmoglobin.

44. What proportion of the body is blood?

A. One twelfth to one-fourteenth of the total body weight.

45. What is coagulation and give its use?

A. Clotting or solidifying. Nature's method of stopping hemorrhage.

46. Name the Fibrin generators.

A. Fibrinogen, Paraglobulin, Fibrin ferment.

47. How may coagulation be aided?

A. 1. Moderate warmth. 2. Rest. 3. Contact with foreign matter. 4. Free access of air. 5. Addition of twice the bulk of water.

48. How may coagulation be retarded?

A. 1. Cold. 2. Contact with living tissues. 3. Imperfect aeration. 4. By addition of strong acids or alkalies. 5. Inflammatory states of the system.

49. What is a blood corpuscle and how many kinds?

A. Small masses of protoplasm with or without cell

walls or nuclei floating in plasma. Two kinds, red and white.

50. Define a red blood cell.

A. Bi-concave circular disc $\frac{3}{1000}$ to $\frac{4}{1000}$ of an inch in diameter. $\frac{1}{12000}$ of an inch in thickness—with cell wall, but without nuclei—having a stroma filled with hæmoglobin.

51. Define a white blood cell.

A. Spherical mass of protoplasm $\frac{2}{3100}$ of an inch in diameter, without cell wall, and containing a nucleus.

52. What is a leucocyte?

A. A white blood corpuscle or cell.

53. What gasses are in the blood?

A. Carbonic acid gas. Oxygen and Nitrogen.

54. In what proportion in arterial and venous blood do we find these gases?

	Oxygen.	Carbonic Acid.	Nitrogen.
<i>A.</i> Arterial,	20 vol. %	39 vol. %	1 to 2 vols.
Venous,	8 to 12 vol. %	46 vol. %	1 to 2 vols.

55. Give four uses of the blood.

- A.*
1. To receive and store up food, drink and oxygen from the outer world and convey them to all parts of the body.
 2. The source from which the tissues of the body may take the materials for their nutrition, and from which the secreting organs can obtain the constituents of their secretions.
 3. To absorb refuse matters from all the tissues and convey them to the eliminating organs.
 4. To warm and moisten the body.

56. What is a circulation and why a circulation of blood?

A. A circulation is a revolution or the passage of a liquid from one point through a certain territory and back to the starting point in the case of the blood. The circulation of the blood is necessary in order that all tissues of the body may come in direct contact with it.

57. When and by whom was the circulation of the blood discovered?

A. In 1618 by Dr. Harvey.

58. What is the Circulatory Apparatus?

A. A central organ, the (1) Heart, connected to a system of closed vessels, the (2) Arteries, (3) Capillaries, (4) Veins.

59. Name and describe two kinds of circulation.

A. 1. Pulmonic—from right ventricle of heart through pulmonary artery to lungs, through them and back to left auricle of heart via pulmonary veins.

2. Systemic—from left auricle through aorta and its branches to and through capillaries of entire system, and back through veins to right auricle of heart. This includes circulation through portal vein, sometimes dignified with name, Portal circulation.

60. Define and locate the heart.

A. The heart is a hollow muscular organ acting as a pump to force the blood throughout the body. It is situated in the thorax, between the lungs, one-third to the right, two-thirds to the left of the sternum; the base directed upward, inward and to the right; the apex directed downward, outward and to the left.

61. Give shape, size, weight and support of the heart.

A. Pyramidal in shape. $5 \times 3\frac{1}{2} \times 1\frac{1}{2}$ inches. Weighs from 9 to 12 ounces, and is supported by the large vessels which are attached to its base.

62. What is the pericardium? Describe and give its use.

A. The pericardium is a membranous sac, enclosing the heart, made up of: 1. An external fibrous membrane attached by its base to the diaphragm and losing its fibres in the external coats of the large vessels at its upper extremity or apex. 2. A serous coat which lines the fibrous coat and is reflected on to the external surface of the heart which it completely invests. The fibrous coat protects the heart and limits its movement. The serous coat secretes a fluid which allows of a free movement of its opposed surfaces upon each other without friction and thus facilitates the heart's action.

63. Locate and describe right auricle.

A. At the right part of the base of the heart viewed from the front. Quadrilateral in shape, prolonged at one corner by a tongue-shaped portion, the right auricular appendix. The interior smooth and lined with endocardium receives the superior and inferior venæ cavæ or great veins conveying blood here from the whole body. It contains small elevated masses of muscular tissue called *musculi pectinati*.

64. Locate right ventricle.

A. Chief part of anterior surface of heart as well as small part of posterior surface. Forms right margin of heart but takes no part in formation of apex.

65. Locate left auricle and tell what vessels enter it.

A. At the left and posterior part of the base of the heart. The pulmonary veins.

66. Locate Left Ventricle and tell what vessel leaves it.

A. Occupies chief part of posterior surface and slight part of anterior surface. The Aorta, the largest artery in the body.

67. Where are the auriculo ventricular openings and what is their use—by what are they guarded?

A. Openings between the auricles and ventricles to allow blood to pass from former to latter. Guarded by mitral and tricuspid valves.

68. Describe the structure of heart and endocardium.

A. The heart is composed of striated or voluntary muscles acting involuntarily. They are placed longitudinally and interlace. In the auricles we find two to three layers, which find their point of attachment in the fibrous rings which are inserted between each auricle and ventricle. In the ventricles we find five to seven layers interlaced in the most intricate manner to secure greatest strength in least compass. The endocardium is the serous membrane lining the heart, covering its valves and becoming continuous with the endothelial inner coat of the arteries and veins which pass from it.

69. Describe and give mode of action of mitral and tricuspid valves.

A. The tricuspid valves present three principal cusps, the mitral two. In both between the principal cusps are smaller ones, so that the tricuspid is composed of six the mitral of four portions. Each portion is triangular in shape, its base continuous with bases of neighboring portions and so forms an annular membrane around auriculo ventricular openings, and is fixed to tendinous ring which encloses those openings. These cusps are composed of fibrous connective tissue strengthened by tendinous cords and covered with endocardium. From the ventricular surface of these cusps tendinous fibres, the *chordæ tendineæ*, pass to the internal walls of the ventricles where they are attached to muscular fibres which project in the form of columns—the *columnæ carneæ*. The valves opening readily by blood pressure from auricles, fold back against ventricular walls until ventricles become full when

they close by blood pressure on their ventricular surfaces and are prevented from passing into auricles and allowing regurgitation of the blood by the tonic contraction of the columnæ carneæ which draw the chordæ tendineæ taut, thus keeping valves closed.

70. Where and of what use are the semi-lunar valves?

A. They guard the openings into the right pulmonary artery from the right and the aorta from left ventricle and prevent the blood from passing out until ventricles are full and from passing back from above arteries into ventricles.

71. What are muscoli papillares?

A. One form of columnæ carneæ which are attached at their bases only to ventricular walls and project into ventricular cavities like teats. They are attached at their free extremity to chordæ tendineæ.

72. What is meant by Systole and Diastole?

A. The Systole—Contraction of auricles or ventricles.
The Diastole—Dilatation of auricles or ventricles.

73. Where does contraction of heart begin and why?

A. At the base—upper part of auricles. To shut off blood from venæ cavæ and pulmonary veins, and that the full auricles may discharge their blood into ventricles and so completely distend them.

74. Describe the contraction of auricles and tell why they contract before ventricles.

A. A sudden, quick contraction from above downwards which sends blood with sufficient force to distend ventricles and by its reflux currents to close mitral and tricuspid valves. Ventricles cannot contract until full, and blood in auricles is needed to fill them.

75. Describe Ventricular contraction.

A. Immediately follows contraction of auricles, but is slower, and more forcible.

76. What change takes place in the shape of ventricles during contraction?

A. The left V. becomes somewhat broader—the right V. slightly shorter.

77. What is the Cardiac Period?

A. The Cardiac cycle or whole time of the heart's action and repose, comprising the auricular contraction, ventricular contraction, and period of repose.

78. What part of the Cardiac period is occupied by the contraction of the auricles, ventricles, and pause?

A. Contraction of auricles = $1 = \frac{1}{10}$ second.

“ ventricles = $2 = \frac{4}{10}$ “

Repose = $2 = \frac{4}{10}$ “

79. What is taking place in the heart during auricular, ventricular contraction and period of repose?

<i>A.</i> Aur. Cont.	{	<i>a.</i> Blood goes to Ventricles.
	{	<i>b.</i> Ventricles distended.
	{	<i>a.</i> Relieving Auricles.
Vent. Cont.	{	<i>b.</i> Closing Auriculo Ventricular valves.
	{	<i>c.</i> Opening Semi-Lunar valves.
	{	<i>d.</i> Forcing blood out.
	{	<i>a.</i> Closing Semi-Lunar Valves.
	{	<i>b.</i> Dilating Auricles.
Repose -	{	<i>c.</i> Relaxing Ventricles.
	{	<i>d.</i> Opening Auriculo Ventricular valves.
	{	<i>e.</i> Filling Ventricles.
	{	<i>f.</i> Distension Auricles.

80. What is the Cardiac impulse?

A. Made by the apex of the heart striking the inner wall of the chest, producing a slight shock.

81. What are the heart sounds?

A. Two sounds heard when the ear is placed over the region of the heart followed by a pause or period of silence.

82. What makes the first sound—where is it heard, and why?

A. A long dull *lubb* sound, caused by closure and vibration of auriculo ventricular valves and the contraction of muscular walls of ventricles. Heard in fifth intercostal space, 1 in. to left of sternum, 2 in. below nipple, because apex of heart striking chest wall at this point communicates sound to chest wall, and so to listening ear.

83. The second sound where heard and why?

A. Short sharp *dub* sound, made by closure of semi-lunar valves and reflux of blood against them in aorta and pulmonary artery. Heard in second intercostal space to the right of sternum, carried here by current of blood in aorta which there closely approaches inner wall of chest.

84. What takes place during first and second sound of heart and pause?

<i>A.</i> 1st sound	{	1. Contracting Ventricles.
		2. First part dilatation Auricles.
		3. Tension Aur.-Vent. valves.
		4. Opening Semi-Lunar valves.
		5. Forcing blood out.
2nd sound	{	1. Tension Semi-Lunars.
		2. Second part dilatation Aur.
		3. Relaxing Vent.
		4. Opening Aur.-Vent. valves.
Pause	{	1. Distention Auricles.
		2. Contraction Auricles.
		3. Distension Ventricles.

85. Give function of auricles and ventricles.

A. Of auricles—to gather blood to completely fill ventricles. Of ventricles—to force blood through system and lungs.

86. What is frequency of heart's action?

A. From 140 at birth to 65 in old age. Contracts 70 to 75 times per minute in healthy adult. Influenced by age, exercise, posture, digestion.

87. What kind of flow of blood leaves the heart, and why?

A. Spurting, forcible flow that the blood may be propelled throughout the body.

88. Compare flow of blood in arteries, veins and capillaries.

A. Fastest in arteries, slower in veins, slowest in capillaries.

89. Name and describe nerves of heart.

A. 1. Local ganglia in heart $\left\{ \begin{array}{l} \text{Remok} \\ \text{Bidder} \\ \text{Ludwig} \end{array} \right\}$ regulating rhythm.
 2. Pneumogastric, or check nerve.
 3. Sympathetic, or acceleuator nerve.

90. Define and describe an artery.

A. Cylindrical vessels carrying blood from the heart to the capillaries of system or lungs, made up of three coats: outer, middle and inner.

91. Define and describe a vein.

A. Cylindrical vessels carrying blood from system and lungs to heart, made up of three coats: outer, middle and inner.

92. What makes the inner coat of an artery?

A. A single layer of endothelial cells placed upon a basement membrane—a continuation of the endocardium.

93. What makes the inner coat of a vein?

A. Same endothelial tissue that lines arteries, because continuous with endocardium.

94. Name and what are the functions of the outer coat of arteries?

- A.* Elastic Coat {
1. To give under sudden pressure.
 2. Equalizes current by elastic recoil.
 3. Adapt arteries to whole amount of blood contained at different times.
 4. Return to normal size when diminished in diameter.
 5. Adapt arteries to various movements of body.

95. What is function of middle coat of arteries?

- A.* Muscular coat {
1. Regulates supply to parts according to their needs.
 2. Adapts calibre of vessel to amount of blood contained.
 3. Causes contraction of end when cut and so stops hemorrhage.

96. Of valves of veins?

- A.*
1. To prevent back flow of blood when pressure is applied to veins from without as in extremities by muscular action.
 2. They thus aid onward flow by means of collateral veins.

97. Describe Capillaries.

A. Small vessels composed solely of endothelial tissue—a continuation of inner coat of arteries and connecting arteries with veins. Diam. $\frac{1}{2500}$ of an inch.

98. What is the Pulse?

A. The wave-like motion imparted to the blood in arteries by the contraction of the ventricles.

99. What arteries supply the heart—How are they filled?

A. Coronary arteries—filled by regurgitation of blood in arteries against closed semi-lunar valves.

100. How are arteries and veins supplied with blood?

A. By a network of small vessels contained in their own walls, called collectively vasa vasorum.

101. What nerves control blood vessels?

A. Vaso motor nerves. Center in medulla oblongata.

102. Name important arteries.

A. Aorta, Pulmonary, Internal and External Iliac, Femoral, Carotid.

103. Name important veins.

A. Inferior and Superior Vena Cava, Pulmonary, Jugular.

104. Give function of arteries.

A. To carry blood from heart to capillaries of entire body.

105. Give function of veins.

A. To carry blood from capillaries of entire body to heart.

106. Give four forces of blood in circulation.

A. 1. Systole and Diastole of heart.

2. Elastic and muscular coats of arteries.

3. Vital capillary force.

4. Muscular pressure on veins with valves, and rhythmic contraction of veins.

107. Give four proofs of a circulation.

A. 1. Ligature around limb very tight will prevent blood from entering.

2. Wound of arteries—flow may be stopped by pressure between cut end and heart. Wounds in veins—flow may be stopped by pressure beyond seat of injury.

3. Results of injecting plaster of Paris in solution.

4. Passage of blood cells seen through small arteries, capillaries and veins in mesentery of living frog under the microscope.

108. What is Respiration?

A. Bringing the atmospheric air into the air cells of lungs in order that its oxygen may be there absorbed by the blood. The carbonic acid gas thrown off by the blood is absorbed by air in air cells and thrown out of body.

109. What is necessary to life?

A. Sufficient oxygen.

110. What part does the blood play in Respiration?

A. Carries CO₂ to lungs and in exchange absorbs oxygen which it carries to all parts of the body.

111. Name the organs of Respiration.

A. Larynx, Trachea, Bronchi, Right and Left Lungs.

112. Describe the Larynx.

A. The organ of speech and upper part of passage that leads only to lungs. Composed of cartilages united by ligaments and muscles and lined with mucous membrane. Covered by cartilaginous lid—the Epiglottis, which is attached at base of tongue and opens and shuts as we breathe. The true and false vocal cords are situated in the upper part and extend from before backwards—the former composed of tendinous material, the latter of folds of mucous membrane.

113. Describe the Trachea.

A. The windpipe. It extends from the fifth cervical vertebra to the third dorsal vertebra, 4 to 4½ inches long, ¾ of an inch in diameter. A tube of fibro elastic membrane, lined with mucous membrane and containing 16 to 20 cartilaginous rings inserted in its walls. These rings extend from before backward two-thirds of the circumference. The back third is composed of muscular fibres which are attached to the free ends of the rings and by their contraction keep the rings tense and so keep the trachea patent, or open for the passage of air. By the

contraction of the fibres the ends of the rings are brought together, thus diminishing the circumference of the trachea.

114. Describe the Bronchi and Bronchial Tubes.

A. The trachea divides opposite the third dorsal vertebra into the two bronchi, right and left, precisely similar in structure to the trachea. These bronchi, on entering the substance of the lungs, divide into smaller and smaller branches which differ in structure from the bronchi in the loss of the cartilaginous rings and the extension of the muscular fibres to form a complete ring. The smaller tubes penetrate every part of the lungs and end in the small subdivisions called lobules. The bronchi and bronchial tubes *are lined with ciliated epithelium.*

115. Describe the Air Cells.

A. The bronchial tubes, on entering a lobule, divide and subdivide into still more minute tubes—the walls formed finally of a thin membrane of elastic and areolar tissue lined with *squamous epithelium not* provided with cilia. Each of these minute terminal branches widen out into pouch like dilatations which are called air cells. The walls of the air cells contain a network of capillary blood vessels so that nothing interposes between the blood in those capillaries and the air in the air cells but the wall of the air cells and of the capillaries.

116. Describe in full the lungs.

A. Occupy the greater part of the Thorax. Composed of spongy elastic tissue, some muscular fibres, bronchial tubes, bronchioles air cells, arteries, veins, capillaries and lymphatics. They are conical in shape, of a pink color, in appearance solid. In reality they are hollow organs, made up of lobules, which are aggregations of air cells, each of which has direct connection with the outer air by the bronchioles, bronchi and trachea.

117. Describe the Pleura and give its use.

A. Each lung is covered with a serous membrane, a closed sac, the inner layer of which covers the lungs closely, the outer layer is reflected over the inner wall of the thorax. Between the two layers is a small amount of fluid which prevents friction during the expansion and contraction of the lungs in respiration.

118. Describe the blood supply of the lungs.

A. The Pulmonary artery bringing venous blood to be purified. The Bronchial artery which brings blood for the nutrition of the tissues of the lungs.

119. Define Inspiration.

A. By a muscular act the chest is enlarged. The pressure on the outside is increased, the air pressure in the lungs diminished. To equalize this pressure fresh air rushes into lungs through trachea and bronchi.

120. Define Expiration.

A. By elastic recoil of lungs and chest walls the chest cavity and lungs are diminished in size and some of the air in lungs is forced out.

121. Describe the Thorax.

A. Large upper cavity of body. Floor, Diaphragm. Anterior wall, Sternum, intercostal cartilages and ribs with muscles covering them. Side wall, ribs and muscles. Posterior wall, spinal column, ribs attached and muscles. Conical in shape, apex up.

122. How and by what is thorax enlarged?

A. In vertical diam. by contraction and descent of Diaphragm. In antero post. diam. by contraction of external intercostals, serratus posticus sup. levatores costorum and portion of internal intercostals between costal cartilages. These by their contraction elevate the ribs.

123. What is meant by forced inspiration and expiration?

A. Extraordinary efforts at enlarging the chest and diminishing its size as in violent exercise.

124. What muscles are used in forced inspiration?

A. In addition to muscles used in answer to question No. 122, the *scaleni sterno mastoid*, *trapezius*, *serratus magnus* and *pectorales* muscles.

125. What muscles in forced expiration?

A. Abdominal muscles, internal intercostals, *triangularis sterni*, *serratus posticus inferior* and *quadratus lumborum* muscles.

126. Name and describe types of respiration.

A. 1. Abdominal in children, muscles of abdomen chiefly used.

2. Inferior Costal in men, lower chest muscles chiefly used.

3. Superior Costal in women, upper chest muscles chiefly used.

127. What are respiratory sounds?

A. Sounds or murmurs heard by the listening ear when applied to chest walls, caused by friction of air as it rushes in against the walls of trachea and bronchial tubes called 1. Bronchial breathing, and 2. Vesicular breathing—sound caused by friction of air in air cells.

128. Give capacity of lungs.

A. About 320 cu. in. Varies with age, stature and weight.

129. Give number of respirations per minute and relation to pulse.

A. In health 14 to 18 per minute, in ratio of 1 to 4 or 5 with pulse beat.

130. Give three uses for muscular tissue of lungs.

- A.*
1. To assist in expiration.
 2. To regulate quantity of air admitted to each part according to quantity of blood in the part.
 3. To aid in expelling collections of mucus.

131. Give composition of atmospheric air. What is used in lungs?

A. By weight nitrogen 75 parts, oxygen 25 parts, 4 to 5 volumes of CO_2 in 10,000. Traces of ammonia and sulphureted hydrogen. Oxygen is abstracted in lungs.

132. Name and define terms used to express quantity of air breathed.

- A.*
1. Tidal air—quantity changed in normal breathing, 30 cu. in.
 2. Complemental air—quantity over and above tidal air that can be inspired, 110 cu. in.
 3. Reserve air—the amount that remains in chest after ordinary expiration but which can be expelled by forcible expiration, 100 cu. in.
 4. Residual air—amount which remains after forcible expiration, which cannot be expelled, 100 cu. in.

133. What changes take place in air after breathing?

- A.*
1. Loss of oxygen, 5 cu. in. to 100 cu. in. of air.
 2. Gain of CO_2 4.5 cu. in. to 100 cu. in. of air.
 3. Increase of water vapor and organic matter.
 4. Elevation of temperature.
 5. Increase or decrease of nitrogen.
 6. Loss in volume.
 7. Gain in ammonia.

134. How do these changes take place.?

A. By virtue of the law of diffusion of gases.

135. What part do the red blood cells play in respiration?

A. Carry oxygen away and CO_2 to the lungs.

136. What changes take place in the blood after breathing, and why?

A. 1. Changes in color from purple to scarlet.

2. Gains O.

3. Loses CO_2 .

4. Becomes cooler.

5. Coagulates better.

137. How does the Diaphragm act?

A. 1. In inspiration it contracts and descends, pushing abdominal contents and walls before it.

2. In expiration it relaxes and is pushed upward by contraction of abdominal walls on intestines and so on it.

138. Name nerves of respiration.

A. 1. Phrenics and Intercostals-motor.

2. Vagus motor, sensory and vaso motor influences.

139. What is Dyspnœa?

A. Difficult breathing due to lack of sufficient O in blood.

140. What is sighing?

A. Prolonged inspiration, gradual expiration producing sound.

141. What is hiccough?

A. Prolonged inspiration, sudden expiration, due to spasmodic action of diaphragm causing quick sound.

142. What is coughing?

A. Prolonged inspiration, sudden expiration against closed glottis, resulting in expulsion of foreign body in air passages, and noisy sound.

143. What is sneezing ?

A. Long inspiration, sudden expiration through nose to drive mucus there out of nostrils, loud, shrill sound.

144. What is speaking ?

A. Voluntary expulsion of air through glottis by means of expiratory muscles. Vocal cords put in proper state of tension by muscles of larynx vibrate as air passes and so produce different sounds, and these sounds are moulded into articulate speech by tongue, teeth, lips, etc.

145. What is laughing ?

A. Series of short, rapid expirations.

146. What is yawning ?

A. Involuntary inspiration accompanied by stretching of muscles of palate and lower jaw.

147. What nerve centre controls respiration, and where is it situated ?

A. Respiratory centre in medulla oblongata.

148. How does the respiratory centre act ?

A. Automatically mostly, but at times reflexly.

149. How is the respiratory centre stimulated ?

A. By the absence of sufficient oxygen in the blood circulating in it.

150. What effects are produced by improper ventilation ?

A. Uneasy sensations as headache, languor, a sense of oppression, fainting, due to the lack of oxygen and presence of too much CO₂, organic matter, etc.

151. What effect has respiration on the circulation ?

A. 1. Inspiration aids circulation and increases arterial tension.

2. Ordinary expiration has no effect upon it but extraordinary expiration obstructs the circulation.

152. What is apnoea?

A. Absence of breathing due to too much O in the blood.

153. Give symptoms of asphyxia by stages.

A. 1. Excessive and difficult breathing.

2. Convulsions.

3. Exhaustion and death.

154. What is necessary in order that life may be maintained?

A. Food in proper quality and quantity.

155. What are the uses of food?

A. 1. To replace waste of tissues.

2. To maintain animal heat.

156. Name the eliminating organs.

A. Lungs, Bowels Kidneys and Skin.

157. What elements are given off by each?

A. 1. Lungs, C. H. O. N.

2. Kidneys, H. O. N.

3. Bowels, H. O. C.

4. Skin, H. O. C. In addition all give off large quantities of H_2O .

158. Define a food.

A. Any substance which, when taken into the body, is absorbed, assimilated when carried to the tissues and which supplies a want.

159. How many kinds of food?

A. Organic and Inorganic.

160. Define them.

A. Organic foods, those derived from living matter. Inorganic, mineral and saline matter and water.

161. How many kinds of organic foods and define them.

- A.* 1. Nitrogenous, those containing C. H. O. N. and some phosphorus and sulphur.
2. Non-nitrogenous, those containing H. O. & C. but no N.

162. Name the nitrogenous foods.

- A.* 1. Proteids—1. Albumen, 2. Casein, 3. Syntonin, 4. Legumin, 5. Gluten.

B. 1. Gelatins—elastin, gelatin, chondrin.

163. Name the non-nitrogenous foods.

A. Amyloid, saccharine or carbo hydrates containing H. O. C. and H. and O. in proportion to form water *e. g.* starch, sugar.

B. Oils and fats, H. O. C. but O. is lacking in the proportion to form water with the H.

164. What common names do we give three foods containing nitrogen?

A. Beef, Mutton, Pork.

165. What substance will do alone for diet, and why?

A. Milk. It contains all the constituents of the various foods we need and in the right proportion.

Nitrogenous { Albumens—Casein in milk covering fat globules.

Non-nitrogenous { Amyloid—Milk Sugar, or Lactose.
Fats and Oils—Fat globules.

Salts—Na Cl, also water.

166. By what foods are carbo hydrates supplied?

A. The cereals, vegetables, fruits.

167. From what do we obtain our fats and oils?

A. Suet of beef and mutton, lard from pork, butter from milk.

168. Are green fruits necessary for health, and why?

A. Yes. Because of the fruit acids they contain. A lack of those acids in our diet gives rise to a scorbutic condition, e. g., scurvy.

169. From what do we obtain our liquid food?

A. Tea, Coffee, Beer, Ale, Wine, Spirits, Cider, Cocoa.

170. What effect has cooking on food?

A. Makes it easily digestible.

Flesh is thus changed: { Albumen, coagulated.
Fibrin, solidified.
Tendons, etc., gelatinized.

Vegetables are softened, their starch grains swollen and bursted, albuminous matter coagulated, saccharine and saline matters removed.

171. Effect of insufficient diet.

A. Hunger, thirst and starvation.

172. Effect of poor cooking.

A. Food is made indigestible and valuable food principles are lost.

173. Define Hunger.

A. A sensation painful and weakening, referable to the stomach, but due to lack of food principles in blood and throughout body.

174. Define thirst.

A. Parched sensation referable to fauces due to lack of fluids in the body.

175. What are some effects of too much food?

A. Causes indigestion or diarrhœa. If excess is absorbed we get in case of nitrogenous foods, general plethora or gout. In case of carbo hydrates we get obesity.

176. What are the requisites of a normal diet?

A. Variety of well cooked articles containing about same amount of carbon and nitrogen as we get rid of by excreta.

177. Define Digestion.

A. The various changes through which the food passes to prepare it to properly supply the waste of the tissues.

178. Name the digestive organs.

A. 1. Alimentary Canal.

Mouth	Small Intestines	{	Duodenum
Pharynx			Jejunum
Oesophagus			Ileum
Stomach	Large Intestines	{	Coecum
			Colon
			Rectum

2. Accessory Organs.

Teeth		Pancreas
Salivary Glands	{	Parotid
		Submaxillary
		Sublingual
		Liver
		Spleen

179. Give diagram showing arrangement, number, and period of eruption of temporary teeth.

Months	Decid. Molars.	Canines	Incisors	Canines	Decid. Molars.	in each jaw=
	24 12	18	9 7 7 9	18	12 24	20 in all.

180. Give diagram showing arrangement, number, and period of eruption by years of permanent teeth.

Molars	Bi. Cusp.	Canines.	Incisors.	Canines.	Bi. Cusp.	Molars	in each jaw
17 12						12 17	
to to 6						6 to to	
25 13	10 9	11 to 12	9 7 7 9	11 to 12	9 10	13 25	=32 in all.

181. Name parts and give structure of a tooth.

A. Crown, part beyond level of gums. Neck, constricted portion embraced by free edges of gum. Fang or root, all below neck, composed of Dentine or Ivory mainly, this contains cavity which is called pulp cavity, because it contains blood vessels, nerves and connective tissue called tooth pulp. The blood vessels and nerves enter tooth at apical foramen—small opening in extremity of fang. The Dentine is covered in crown portion with enamel, fang is covered with Crusta Petrosa or cement. Neck also covered by enamel which here joins cement.

182. Give chemical composition of Dentine.

A. 28% animal and 72% earthy matter.

183. Describe the structure of Dentine.

A. Made up of many delicate tubules $\frac{1}{45000}$ of an inch in diameter, communicating by their inner ends with pulp cavity, their outer ends coming in contact with enamel and cement. The tubules contain fine prolongations of the tooth pulp which are processes of the odontoblasts or dentine cells, lining pulp cavity and which give the dentine sensitiveness and nutrition.

184. Describe structure and composition of enamel.

A. Hardest tissue in body, contains only 2 to 3% animal matter, 97 to 98% earthy. Made up of fine hexagonal fibres $\frac{1}{30000}$ of an inch in diameter. These are set on end upon surface of dentine and fit into depressions of same. These enamel prisms radiate in such a manner from the dentine in wavy parallel curves, that at top of tooth they are vertical, at sides more horizontal. Enamel is covered by thin calcified membrane called the cuticle of the enamel.

185. Describe Crusta Petrosa.

A. Outer covering of fang, composed of true bone con-

taining lacunæ and canaliculi. No Haversian Canals except in thickest portion.

186. From what tissue are the teeth developed?

A. Epithelial tissue covering jaws.

187. What is the primary enamel organ or enamel germ?

A. Downward growth from stratified epithelium of mucous membrane of the mouth. This becomes thickened along central portion of free surface of jaws. The process passes downward into enamel groove of embryonic jaw. The groove and enamel germ elongate downward and the deeper part inclines outward and becomes bulbous, the upper part becomes constricted forming the neck. There is then an increased development of the bulbous part at points corresponding to the situation of future milk teeth. The common enamel organ becomes divided in its deeper part into special enamel germs, corresponding to the milk teeth, which are finally placed each in a special recess of the jaw and connect with the common enamel organ only by the neck. The enamel germ is the membrane which later becomes calcified and so forms the enamel of the completed tooth.

188. Describe a dental papilla and dental sac.

A. The upward growth from underlying tissue at base of enamel groove—of a vascular papilla—which meets decending enamel organ, and pushing up becomes covered as by a cap by enamel organ. While the central part of the sub-epithelial tissue forms dental papilla, the part which bounds embryonic tooth forms the dental sac. The jaw below sends up processes which form partitions between the teeth, so small chambers are made in which the dental sac and enclosed enamel organ and papilla are contained. The outer layer of columnar cells covering papilla are called odontoblasts and these form the dentine, the remainder of the papilla forming the tooth pulp.

189. From what is the cement or crista petrosa formed.

A. From the tissue of the tooth sac which contains a layer of osteoblasts or bone-forming cells.

190. What is the cavity of reserve?

A. A small sac set by from the sac of the temporary tooth, from which a permanent tooth is developed.

191. What is mastication?

A. Crushing, grinding, pulverizing and insalivating food, by the movement of teeth of lower jaws against those of upper jaw, assisted by the simultaneous movements of tongue and cheeks. Lower jaw is moved against upper, as a fixed body by masticatory muscles.

192. Name, locate and describe salivary glands.

A. 1. Parotid, below and in front of external ear-true salivary gland.

2. Submaxillary, below the jaw in submaxillary triangle, muco-salivary or mixed gland.

3. Sublingual, in floor of mouth close to symphysis of jaw, true mucous gland. In structure all are compound tubular glands, made up of lobules, the pouched ends of the smallest tubes containing the proper secreting cells of the glands.

193. Describe Saliva.

A. Pure saliva from parotid is clear watery fluid, alkaline in reaction sp. gr. 1004 to 1008. In mouth contains epithelial cells, mucous, etc., and is called mixed saliva.

Mixed saliva chem. comp.	{	Water,	994.1 parts.
		Ptyalin,	1.4 "
		Salts,	2.29 "
		Fats,	trace.
		Proteids,	2.13 "

194. What is a ferment?

A. Any substance which when brought in contact with another substance changes its character, without itself undergoing change or suffering diminution.

195. To what is the action of saliva due?

A. Mainly to the ferment Ptyalin which it contains.

196. Name two uses of saliva.

A. 1. Mechanical, $\left\{ \begin{array}{l} a. \text{ Keeps mouth moist.} \\ b. \text{ Dissolves sapid substances.} \\ c. \text{ Makes food into soft mass, easily} \\ \text{swallowed.} \end{array} \right.$
2. Chemical, Ptyalin converts starchy matters into sugar.

197. How may chemical action be aided?

A. 1. By moderate heat.
2. Alkaline medium.
3. Removal of changed material.

198. How much saliva is secreted in 24 hours?

A. One to three pints.

199. What will stimulate action of salivary glands?

A. 1. Irritation of mucous membrane of mouth or stomach.
2. Movement of masticatory muscles.
3. Sight or smell of food : hearing food prepared.
4. By mental emotions.

200. What is the pharynx?

A. Portion of alimentary canal which lies between mouth and œsophagus, constructed of series of three muscles, called constrictors of pharynx, bound together by connective tissue and lined with mucous membrane continuous with that lining mouth.

201. Describe tonsils.

A. Between anterior and posterior arches of soft palate, one on each side; each consists of an elevation of mucous membrane with 15 to 20 orifices, leading into crypts, in which are nodules of adenoid tissue. The viscid secretion that exudes from above orifices lubricates bolus of food as it passes in swallowing.

202. Describe œsophagus or gullet.

A. Narrowest part of alimentary canal. Muscular and mucous tube, 9 to 10 in. long, from lower end of pharynx to cardiac orifice of stomach.

Has four coats {
1. External—fibrous.
2. Muscular.
3. Sub-mucous.
4. Mucous.

203. What is deglutition?

A. Act of swallowing food after mastication. A reflex muscular act.

204. What prevents food from going into trachea?

A. The epiglottis, which acts as a lid or cover to larynx, and the upper surface of which acts as an inclined plane along which bolus of food slides.

205. How does food pass through œsophagus?

A. By the dilatation of muscular fibres of œsophagus before bolus of food and their immediate contraction on bolus and behind it.

206. Locate and describe stomach.

A. Situated in left hypochondriac, epigastric and part of right hypochondriac regions. The principal organ of digestion. A pear shaped dilatation of alimentary canal, placed between and continuous with œsophagus at its

cardiac orifice, and small intestine at its pyloric orifice.

Has four coats: { 1. External or Peritoneal.
2. Muscular—longitudinal, circular, oblique.
3. Submucous.
4. Mucous.

207. Describe peculiarity of mucous membrane lining stomach.

A. In dilated state is smooth, pink and velvety. In contracted state is thrown into numerous folds or rugæ, and presents a peculiar honey-combed appearance.

208. Describe glands of stomach.

A. 1. Peptic, found throughout stomach, except at pylorus. Two or three tubes open into one duct which forms about $\frac{1}{3}$ of length of tube and opens on the surface. The remainder of tube is divided into the neck and dilated end—the body. The duct is lined with columnar epithelium; the neck contains parietal cells which secrete hydrochloric acid; the cubical cells in body of glands secrete pepsin.

2. Pyloric, found near pylorus. Tubes larger than in peptic glands; wavy and convoluted; devoid of parietal cells. Central cells probably secrete mucous only.

209. What is gastric juice? and give its composition.

A. The digestive fluid secreted actively when food is introduced into the stomach.

Chem. Comp.	{	Water, - - -	994.4
		Ferment Pepsin,	3.19
		Hydrochloric acid,	.2
		Salts, - - - -	2.10

210. What are ends of the stomach called?

A. The cardiac end near the heart, the pyloric end. The greater end or fundus, the lesser end or neck.

211. How much gastric juice is secreted in 24 hours?

A. Ten to twenty pints.

212. What are chief changes resulting from stomach digestion?

- A.* 1. Proteids changed to peptones and parapeptones.
2. Milk is curdled, casein dissolved.
3. Dissolves sapid substances.
4. Prevents putrefaction.

213. What is the time of gastric digestion?

- A.* Three to four hours, more or less.

214. How may time be modified?

- A.* 1. Nature of food.
2. Quantity of food.
3. Time since last meal.
4. Amount of exercise before and after meals.
5. State of mind.
6. Bodily health.

215. Why must proteids be changed to peptones?

- A.* Because proteids are not dialyzable, that is, cannot pass readily through an animal membrane, and cannot therefore be absorbed. Peptones are highly dialyzable and are readily absorbed.

216. What are uses of muscular coats of stomach?

- A.* 1. Adapt size of stomach to quantity of food contained.
2. Keep openings closed until digestion is complete.
3. To perform peristaltic movements, thus, mixing food with gastric juice and propelling it toward pylorus when digested.

217. What effect does state of mind have on digestion?

- A.* If mind is tranquil and at rest it aids digestion. If busy or under the influence of grief, etc., it retards it.

218. Describe small intestines.

A. Musculo membranous tube $1\frac{1}{4}$ in. in diam., 20–21 ft. long, extending from pyloric orifice of stomach to juncture with coecum at ilio-coecal valve.

4 divisions	{	Duodenum, 1st 12 in. Jejunum, $\frac{2}{3}$ of rest. Ileum, $\frac{1}{3}$ of rest.
4 coats	{	Peritoneal, external. Muscular—longitudinal, transverse. Submucous. Mucous.

219. Describe large intestines.

A. Four to six feet long; a continuation of small intestines, divided into coecum, a wide pouch communicating with small intestines by Ilio-coecal valve; the colon continuous with coecum, ending in rectum, which, after dilating at its lower part, contracts and opens externally through anus. The appendix vermiformis is attached to coecum. The coats of large intestines are same as those of small intestines.

220. What, where, and of what use are the villi?

A. Minute vascular processes covering surface of mucous membrane in small intestines; they absorb chyle and other liquids from the intestines by means of lacteal and blood vessels they contain.

221. What, where and of what use are the valvulae conniventes?

A. Folds of mucous membrane arranged transversely to axis of small intestine. Each fold extends from $\frac{1}{2}$ to $\frac{2}{3}$ of circumference of intestine. They do not disappear on distension of canal.

Function	{	1. Increase surface for secretion and absorption. 2. Prevent too rapid passage of chyle. 3. Mix contents more perfectly with secretions of intestines.
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222. What do we call the secretions of intestine?

A. Succus entericus, or intestinal juice, made up of the secretions of glands of (1) Brunner, (2) Peyer, (3) Lieberkuhn, (4) Mucous.

223. Locate pancreas and give function.

A. Situated in curve formed by duodenum, transversely across posterior wall of abdomen. A compound racemose gland analogous to salivary glands in structure, 6 to 8 inches long by $1\frac{1}{2}$ inches broad by $\frac{1}{2}$ to 1 inch thick. It secretes an important digestive fluid, the pancreatic juice.

224. Describe pancreatic juice.

A. A colorless, transparent, slightly viscid liquid, alkaline in reaction, sp. gr. 1010 to 1015. Contains important ferments: 1. Trypsin. 2. Amylopsin. 3. Remmet. 4. Steapsin.

225. Give function of trypsin.

A. Converts proteids into peptones.

226. Locate liver.

A. Situated in right hypochondriac region and extends across epigastrium into left hypochondrium.

227. Describe liver.

A. Largest gland in body. Wt. 3 to 4 lbs. Extremely vascular. Receives blood for its nutrition through hepatic artery—blood to be changed, through portal vein. It is made up of oval portions called lobules, $\frac{1}{20}$ of an in. in diam. each of which is composed of minute branches of the portal vein, hepatic artery, hepatic duct and hepatic vein. Between the minute branches of these vessels are the hepatic cells, $\frac{1}{800}$ of an in. in diam., which are the secreting parts of the liver. The lobules are bound together by connective tissue into lobes.

228. What functions has the liver?

- A.* 1. Secretion of bile.
2. Elaboration of blood and glycogenic function.

229. Name its lobes and describe Glissons capsule.

A. (1) right, (2) left, (3) lobus spigelii, (4) lobulus caudatus, (5) lobus quadratus. Glissons capsule is a sheath of areolar tissue continuous with the fibrous external coat which passes into the liver, covering the portal vein, hepatic artery and hepatic duct, and accompanies them in all their branchings.

230. Where is the bile secreted and from what?

A. In the hepatic cells from blood brought there by the capillaries of the portal vein. It is gathered up by the minute hepatic ducts.

231. Describe the portal vein as it enters and divides in liver.

A. After entering the liver at the transverse fissure it divides into small branches, which divide between the lobules, surrounding and limiting them—thus called, *inter-lobular* veins. From these *inter-lobular* veins a dense capillary network passes into substance of lobules which converges and empties into a single small vein in centre of lobule—so called, *intra-lobular* veins. The *intra-lobular* veins empty into minute veins at the base of each lobule—called hence, *sub-lobular*—and these converging, by their union, form the main branches of the *hepatic* veins.

232. Describe the hepatic duct.

A. The hepatic duct divides in like manner with portal vein. The capillaries of the hepatic duct forming a network in the lobules, are thus brought into direct contact with the hepatic cells and so readily receive the bile from them as secreted. They pass out at circum-

ference of lobule and empty into an *inter-lobular* duct surrounding lobule. These unite one with another to form two main ducts—one from the right, the other from the left lobe—which pass from the liver at the transverse fissure and by their union form the hepatic duct.

233. Describe common bile duct and give use.

A. Formed by union of cystic and hepatic ducts. 3 in. long. The common excretory duct of liver and gall bladder.

234. Describe and locate gall bladder.

A. A pear shaped membranous sac located in a fossa on the under surface of the right lobe of the liver. Has an external serous coat, middle fibro muscular, and internal or mucous coat. Four inches long, 1 in. broad, capacity 8 to 10 drachms.

235. Give function of gall bladder.

A. Reservoir for collection of bile secreted during intervals of digestion.

236. Give function of bile.

A. 1. An excrementitious substance.

2. A digestive fluid	{	1. Emulsifies fats.
		2. Moistens mucous membrane.
		3. An antiseptic.
		4. Natural purgative.
		5. Precipitates pepsin, peptones, para-peptones.

237. What does chyme contain.

A. 1. Albuminous matter broken down, dissolving, half dissolved.

2. Fatty matter broken down, melted but not dissolved.

3. Starch slowly changing to sugar.

4. Sugar dissolving.

5. Gastric fluid and fluids swallowed.

6. Indigestible foods.

238. What does chyle contain?

A. 1. Fatty molecules.

2. Proteid matter in fluid state.

3. Small amount of extractives and salts.

239. How do the salts and sugars enter the circulation?

A. By osmosis, or the property which they possess of passing through an animal membrane without pressure.

240. How do fats and oils?

A. By filtration. That is, they pass through an animal membrane under pressure.

241. Define absorption.

A. 1. The introduction into the blood of fresh food material and air, or whatever comes in contact with the internal or external surface.

2. Gradual removal of parts of body when they need renewal.

242. Through what vessels is absorption accomplished?

A. The blood vessels. The lymphatics.

243. Give structure of lymph capillaries?

A. Similar to blood capillaries. Single layer of endothelial cells cohering along edges to form tube. Calibre larger than that of blood capillaries and varies greatly; numerous communications exist with lymph canalicular system.

244. What is the lymph canalicular system?

A. Irregular spaces which exist throughout most tissues and gather up fluid and worn out solid matter from the cells of such tissues. They finally discharge contents into lymph vessels and are one of the modes of origin of lymph capillaries.

245. Describe lymph; tell what it contains and where it goes.

A. A clear, transparent, yellowish fluid, slightly alkaline; contains corpuscles similar to white blood corpuscles which float in an albuminous fluid; slight amount of extractives and salts. It finally is emptied into the general blood current at the junction of the jugular and subclavian veins on the right and left sides, respectively.

246. What is animal heat?

A. The average temperature at which animal bodies are maintained.

247. Give normal temperature of human body; upon what does it depend?

A. 98.6° to 99.5° ; depends upon age, sex, period of day, exercise, climate and season, food and drink.

248. What is the source of animal heat?

A. Arises from combustion due to the fact that the oxygen of the air is ultimately combined with carbon and hydrogen from food and drink, and discharged from body as CO_2 and H_2O .

249. How is temperature of body regulated?

A. By mechanisms which permit of (1) variation in amount of heat got rid of; (2) variation in amount of heat produced.

250. By what is heat given off.

A. 1. By the skin. 2. By the lungs. 3. Slightly by kidneys and bowels.

251. Give loss of heat by skin; how do you account for it?

A. Seventy to eighty per cent. of whole amount.

1. Offers large surface for radiation, conduction and evaporation.
2. Contains large amount of blood.
3. Quantity of blood in it is increased when loss of heat is necessary and vice versa.

252. How regulate amount of heat lost in different climates?

A. By varying weight of external coverings, as clothing.

253. How regulate amount of heat produced?

- A.* 1. By varying quantity and quality of food taken.
2. By exercise.
3. By influence of nervous system.

254. Define secretion.

A. Process by which cells of secreting organs separate materials from the blood and elaborate them to serve some useful office in the body.

255. Define excretion.

A. Process by which cells of excretory organs separate useless or injurious material from the blood and discharge it from the body. Excretions exist ready formed in the blood and thus require no making over but merely separation.

256. What is necessary for a secreting gland?

A. 1. A primary or basement membrane. 2. Certain cells. 3. Blood vessels.

257. Name and locate secreting membranes.

- A.* 1. Mucous membranes lining open cavities of body.
2. Serous and synovial membranes lining closed cavities of body.

258. Name kinds of secreting glands and give example of each.

- A.* 1. Simple tubular. 2. Compound tubular.

{
Sudoriferous glands.

{
Kidneys.

3. Racemose.

{
Neibomian follicles.

259. Describe the process of secretion.

- A.* 1. Physical { 1. Filtration—passage of fluids through porous membrane under influence of pressure.
2. Dialysis—passage independent of pressure, or in opposition to it,
2. Chemical—the formation of new materials by the secreting cells from the plasma exuding from the blood vessels.

260. What circumstances influence secretion?

- A.* 1. Variations in quantity of blood supplied.
2. Variations in quantity of peculiar materials for any secretion which the blood may contain.
3. Variations in condition of nerves of glands.

261. Give offices of skin.

- A.* 1. To cover and protect deeper tissues.
2. Sensitive organ in exercise of touch.
3. Secretory and excretory organ.
4. Absorbing organ.
5. Regulates temperature of body.

262. Name the layers of skin.

- A.* 1. Derma or true skin.
2. Epidermis or cuticle { 1. Stratum corneum or horny layer.
2. Stratum lucidum or lucid layer.
3. Stratum granulosum or granular layer.
4. Stratum malpighii or many strata.

263. What are found in derma?

A. Papillæ ducts of sweat glands, sebaceous glands, hair follicles, blood vessels, nerves and lymphatics. Derma is a dense, tough, highly elastic structure, composed of areolar tissue and many plain muscular fibres; resting upon a layer of adipose and cellular tissue.

264. What found in epidermis?

A. Ducts of sweat and sebaceous glands, hairs and nails. It is composed of many strata of cells, and resembles epithelium of mucous membrane of mouth.

265. Describe glands of skin.

A. 1. Sudoriferous or sweat glands—each a small lobular mass formed of a coil of tubular gland duct, surrounded by blood vessels and imbedded in subcutaneous adipose tissue. Mouth of duct opens on surface of skin where its secretion of sweat is poured out.

2. Sebaceous glands—minutely lobulated glands composed of an aggregation of small tubes filled with substance like soft ointment. They are abundantly covered with capillaries and their duct opens into follicle of hairs, or on surface of skin near hairs. Most abundant on hairy parts of body.

266. Name the urinary organs.

A. Right and left kidney. Right and left ureter. Bladder. Urethra.

267. Give shape, size, weight and support of kidneys.

A. Bean shaped; 4 in. long, $2\frac{1}{2}$ in. broad, $1\frac{1}{2}$ in. thick; weight, $4\frac{1}{2}$ to 6 oz. Supported by masses of fat in which they are imbedded, and the large blood vessels which enter and leave them.

268. Of what is the kidney composed.

A. A compound tubular gland. The cortical and medullary portions are both composed essentially of secreting tubes, the *tubuli uriniferi*, which end in the cortical or outer portion in little pouches containing blood vessels and called Malpighian bodies. The medullary or inner end of these tubes open through papillæ into the pelvis of the kidney and so discharge urine which they

secrete. Between the tubes and vessels of the kidney which make up its substance, is a fine matrix of areolar tissue. The kidney is covered by a tough fibrous capsule which becomes continuous at the hilus with the external covering of the ureter. Nerves derived from renal plexus.

269. Describe the cortical portion.

A. The outer portion of kidney immediately beneath the capsule. It is reddish brown in color, soft and granular. It is composed of convoluted and straight tubes—the *tubuli uriniferi*—of blood vessels, nerves and lymphatics. Many little red masses are scattered throughout its substance called malpighian bodies.

270. Describe the medullary part.

A. Consists of from 8 to 18 reddish conical masses called pyramids of Malpighii. The base of each pyramid is surrounded by a cortical arch and directed toward the outside. The apex known as a papilla projects into one of the calices or cup-shaped tubes of the pelvis of the kidney. The pyramids are each composed of a bundle of the straight collecting parts of the *tubuli uriniferi*.

271. How does the kidney get its blood supply.

A. By the renal artery, a branch of the abdominal aorta, which enters at the hilus. It here divides into several branches. Some pass vertically to the surface giving off branches to supply the Malpighian bodies. Others pass horizontally, sending branches up to the cortex and down to the medulla. The small *afferent* artery entering a Malpighian capsule or pouch-like end of a uriniferous tubule, breaks up into a fine-looped capillary plexus which is gathered up again into a single small *efferent* vessel which passes out of capsule near point where afferent artery entered. The capillary plexus described is called the glomerulus or capillary tuft. The efferent

vessel as soon as it leaves capsule breaks up into another capillary plexus on external wall of capsule. This second plexus unites finally in a small vein which by union with others like it, finally produces the renal vein which passing out at hilus empties into inf. vena cava.

272. Describe the pelvis and hilus.

A. The pelvis is a membranous cavity situated at the superior part of the ureter, with which it is continuous. Into it open 7 to 13 cup-like tubes called calices. The hilus is a notch or fissure on internal border of kidney about at centre.

273. Describe in brief the process of the excretion of urine.

A. 1. The watery parts and salts in solution are thrown into cavity of malpighian capsule by filtration of blood in capillary vessels of glomerulus.

2. True secretion, by which the epithelial cells lining the convoluted tubes separate from the blood the principal urinary solids, as urea, etc.

274. Give office of urethra.

A. To conduct urine from urinary bladder to outer world.

275. Locate, describe, and give functions of urinary bladder.

A. A pear shaped musculo membranous sac situated in the pelvis behind the pubes, in front of the rectum in the male, the uterus and vagina intervening between it and rectum in the female. It is a reservoir for collecting the urine preparatory to voiding it and holds about one pint.

276. How may the secretion of urine be aided and retarded.

- A. 1. Aided { 1. By increasing general blood pressure.
2. By increasing local blood pressure by relaxation of renal artery without relaxation elsewhere.
2. Retarded { 1. By diminishing general blood pressure.
2. By constriction of renal artery by nerve influence.

277. What is composition of urine?

A. Water	-	-	-	767.
Urea	-	-	-	14.23
Other nitrogenous crystalline bodies	-	-	-	10.635
Salts	{	Inorganic	}	- 8.135
		Organic	}	<u>1000.</u>

Gases Nitrogen and CO₂.

278. What is the source of urea?

- A. 1. Splitting up of elements of nitrogenous food.
2. From nitrogenous metabolism of the tissues.

279. Locate and give function of spleen.

- A. To left of stomach between it and diaphragm.
1. It elaborates albuminous food and stores it up.
 2. Forms blood corpuscles.
 3. Worn out red blood corpuscles here undergo disintegration.
 4. Scene of special nitrogenous metabolism.
 5. Vascular reservoir to portal system of vessels of stomach.

280. Give function of thyroid and thymus glands.

- A. Supposed to aid in the elaboration of the blood.

281. Name two chief kinds of muscular tissue.

- A. 1. Striated or voluntary.
2. Plain, non-striated or involuntary.

282. How may muscles exist.

A. 1. During rest, 2. During activity, 3. In rigor.

283. What is their physical condition during rest.

A. They have a slight but perfect elasticity; oxygen is abstracted from blood and CO₂ given out; alkaline in reaction.

284. By what properties of muscular tissue are its functions exercised?

A. 1. By its contractility. 2. By its sensibility.

285. How may contractility be called forth?

A. By stimuli applied to muscle or nerve supplying muscle, either (1) mechanical, (2) thermal, (3) chemical, or (4) electrical stimuli.

286. What are the accompaniments of muscular contraction?

A. 1. Heat. 2. Sound.
3. Changes in shape. 4. Chemical changes.

287. What is reaction of muscle after activity?—to what due?

A. Acid. Due to developement of sarcolactic acid.

288. What is the cause of rigor mortis?

A. The coagulation of the muscle plasma.

289. Of what use are the voluntary muscles of the body?

A. Act as source of power for removing levers—the latter, the bones to which muscles are attached. Thus we stand, walk, run, etc.

290. Of what use the involuntary muscles?

A. Form walls of such hallow parts as need to diminish their calibre under certain circumstances, *e. g.*, blood vessels, intestines, etc.

291. What is the average total income of the body per day in grains?

A. 58,650.

292. What are the sources and objects of expenditure?

- A.*
1. Common wear and tear.
 2. Manifestation of force in form of heat or motion.
 3. Manifestation of nerve force.
 4. Energy expended in physiological processes as nutrition and secretion.

293. Describe the production of the human voice.

A. A sound produced by the vibration of the true vocal cords which bound the glottis. Caused by currents of expired air impelled over their edges.

294. Describe the laryngoscope.

A. Consists of a large concave mirror with hole in centre, and of a smaller mirror on a long handle. By means of a large mirror, light—placed behind and above head—is reflected into open mouth of patient. The small mirror is placed with its back against uvula and the light directed on it, when—if at the right angle—an inverted image of interior of larynx, vocal cords, etc., will be seen reflected from surface of small mirror.

295. Give the divisions of the nervous system.

A. 1. The cerebro spinal. 2. The sympathetic.

296. Of what two elements are all nervous tissues made up?

A. 1. Nerve fibres. 2. Nerve cells.

297. What is a nerve trunk composed of?—nerve ganglia?

A. Bundles of nerve fibres form a nerve trunk. Collections of nerve cells with some fibres, form nerve ganglia.

298. What two varieties of nerve fibres have we?

- A.* 1. Medullated or white fibres.
2. Non-medullated or gray fibres.

299. According to function, how are all nerve fibres named?

- A.* 1. Centripetal or afferent.
2. Centrifugal or efferent.
3. Intercentral.

300. What may conduction in centripetal nerves cause?

- A.* 1. Pain or some kind of sensation.
2. Special sensation.
3. Reflex action.
4. Inhibition or restraint of movement.

301. Conduction in centrifugal nerves.

- A.* 1. Contraction of muscles (motor nerves).
2. May influence nutrition (trophic nerves).
3. May influence secretion (secretory nerves).
4. Inhibit, augment, or stop any other efferent action.

302. What is the velocity of nerve force?

- A.* Motor nerves, 111 ft. per second. Sensory nerves, 140 ft. per second.

303. Name some terminations of sensory nerves. Locate.

- A.* 1. Pacinian corpuscles on hands and feet.
2. End bulbs in conjunctiva.
3. Touch corpuscles papillæ of skin of fingers.

304. Give functions of nerve centres.

- A.* 1. Conduction. 2. Transference.
3. Reflection. 4. Automatism.
5. Augmentation. 6. Inhibition.

305. Locate and describe spinal cord.

A. Contained in vertebral canal. A cylindrical column of nerve substance, connected above with the brain by the medulla oblongata, and terminates below about the lower border of the first lumbar vertebra in a slender filament of gray substance, which lies in the midst of the roots of many nerves forming the *cauda equina*. It is 16 to 17 in. long, wt. $1\frac{1}{2}$ oz.; in proportion to encephalon of 1 to 33.

306. Name and describe coverings of spinal cord.

- A.*
1. Dura Mater—external fibrous membrane, for protection.
 2. Arachnoid—middle, delicate membrane lined on free surface by an endothelial membrane.
 3. Pia Mater—internal, double layered membrane, very vascular.

307. Describe arrangement of white and gray matter in spinal cord.

A. White—external, constitutes chief portion. Gray—internal or axial portion, appears in cross section like two crescentic masses connected by narrow isthmus.

308. Give origin and distribution of nerve roots.

A. Anterior roots arise from the anterior columns of cord, and more deeply from multipolar cells in ant. cornua of gray matter. Made up of centrifugal fibres and conveys motor impulses to body. Posterior roots arise from posterior columns of cord and are composed of centripetal fibres conveying sensory impressions to cord from all parts of the body.

309. Describe columns of cord.

A. Each half of spinal cord is divided by two longitudinal furrows on its sides, into three portions or columns. The anterior column extends from the ant. commissure to the first longitudinal furrow. The lateral column lies on each side between two longitudinal furrows. The posterior column lies between second longitudinal furrow and posterior commissure.

310. Give function of white matter of cord.

A. Mainly the conduction of motor and sensory impressions.

311. Give function of multipolar nerve cells.

A. To transfer and originate motor impulses.

312. Give function of gray matter.

A. Transference and reflection.

313. Name the tracts of the cord.

A. 1. Direct pyramidal. 2. Anterior ground fibres. 3. Antero-lateral ascending tract. 4. Direct cerebellar. 5. Crossed pyramidal tract. 6. Lateral limiting layer. 7. Posterior external tract. 8. Posterior median column.

314. What symptoms would result from injury producing pressure upon both sides of spinal cord at any point?

A. Partial or complete paralysis of both motion and sensation below seat of pressure.

315. What symptoms would be produced if one-half of cord was destroyed?

A. Paralysis of motion below injury on same side. Paralysis of sensation on opposite side below injury.

316. What are nervous impulses, and how many kinds?

A. Molecular motion over a nerve fibre to nerve centre, being a sensory impulse. From nerve centre to periphery, being motor.

317. Where do motor and sensory impulses have their origin?

A. Motor in brain or nerve centre. Sensory at peripheral termination of fibres.

318. What do we mean by special nerve centres, and name some special centres in cord?

A. Special nerve centres are centres which control the actions of organs or sets of muscles—being however, subsidiary to higher centres—under certain circumstances. Centres for defecation, micturition parturition.

319. Locate and describe the Medulla Oblongata.

A. At upper end of cord and connects it with brain. Formed by a widening out of columns of cord. Composed of gray and white substance. Rests upon basilar groove of occipital bone. Its columns are pyriform and continuous with those of cord, and it is divided into the anterior and posterior pyramids, restiform and olivary bodies.

320. Name special centres of Medulla with example of each.

- A.*
1. Simple reflex centre—mastication.
 2. Automatic centre—respiration.
 3. Control centre—sweat centre controlling spinal sweat centres.
 4. Tonic centre—vaso motor.
Special centre for hearing and taste.

321. Give functions of Medulla.

- A.* 1. Conduction. 2. Reflection. 3. Automatism.

322. Locate, describe and give function of Pons Varolii.

A. Situated above medulla, below *conra cerebri*, and between hemispheres of cerebellum. Made up of transverse and longitudinal fibres which make it in truth a bridge conducting impressions from one part of cerebro spinal axis to another.

323. Locate, give shape and weight of cerebrum.

A. Enclosed in the skull, resting upon the anterior and middle fossæ of the base of the skull, and behind upon a membrane—the *tentorium cerebelli*. Divided into two hemispheres by the great longitudinal fissure. Its upper surface is ovoidal in form and convex. The two hemispheres are connected by a broad band of white matter—the *corpus collosum*—which is seen, upon separating them, lying at the bottom of the longitudinal fissure. Weight, about 3 lbs.

324. What, where, and of what use is the *falx cerebri*?

A. A strong process of the *dura mater*, which descends into the longitudinal fissure and is attached to the *tentorium cerebelli* behind. It is like a double layered partition separating the two hemispheres, and contains the blood vessels supplying the hemispheres with blood.

325. Of what is the Cerebrum composed?—how is it arranged and divided?

A. Of gray and white nerve substance. The gray externally; the white, made up of bundles of medullated nerve fibres, forms the bulk of the cerebrum and is internal. The cerebrum is divided into lobes by fissures which are readily seen upon its surfaces.

326. What are the convolutions of the Cerebrum? By what are they outlined, and what do they indicate?

A. Small eminences seen covering the surfaces of the cerebrum. Separated from each other by depressions of various depths called sulci. The outer surfaces of the convolutions and intervening sulci are composed of gray matter—the cortical substance. The greater the number of convolutions and the depth of the intervening sulci the greater the intellect of the individual.

327. Describe and give function of corpus callosum.

A. A thick stratum of transverse white fibres exposed at the bottom of the longitudinal fissure, connecting the two hemispheres and forming the roof of a space in the interior of each hemisphere—the lateral ventricle. Its function is the conduction of the nerve impulses from the cortex of one hemisphere to the cortex of the other.

328. Describe the septum lucidum and tell what it contains.

A. A thin semi-transparent membrane attached above to the under surface of the corpus callosum below to the fornix. It thus forms a double partition between the lateral ventricles. Between its two walls an interval filled with fluid, the fifth ventricle, is contained.

329. What and where is the foramen of Monro?

A. A “Y” shaped opening between the two lateral ventricles above and the third ventricle below.

330. Locate third ventricle and tell how it communicates with the fourth ventricle.

A. Narrow, oblong fissure between optici thalami, extending to base of brain. The iter a tertio ad quartum ventriculum or aqueduct of Sylvius.

331. Give functions of Corpora Quadrigemini.

- A.*
1. Principal nerve centres for visual sensations.
 2. Centre governing movements of iris.
 3. Centre for co-ordination of movements of the eyes.

332. Give functions of the Cerebrum.

- A.*
1. Organ by which are perceived sensations which can be retained and regarding which we can judge.
 2. Organ of the will.
 3. Retains impressions of sensible things, reproducing them in subjective sensations and ideas.
 4. Medium of all high emotions and feelings, of memory, judgment, understanding, reflection, imagination.

333. How may sleep be produced?

A. By any agency that will reduce the amount of blood supplied to the brain or produce anaemia of that organ.

334. How many pairs of cranial nerves and give their origin.

A. Twelve pairs and all arise from the base of the encephalon in a double series—from the under surface of the anterior cerebral lobes to the lower end of the medulla.

335. Name the nerves of special sense.

A. Olfactory, Optic, Auditory, part of Glasso Pharyngeal, and part of the Fifth.

336. Name the nerves of motion.

A. Third, Fourth, lesser division of Fifth, Sixth, Facial, Hypoglossal.

337. Name the nerves of common sensation and mixed nerves.

A. Common sensation, greater part of Fifth.

Mixed nerves, $\left\{ \begin{array}{l} \text{Glosso Pharyngeal.} \\ \text{Vagus.} \\ \text{Spinal accessory.} \end{array} \right.$

338. Describe the origin of the Fifth nerve.

A. The fibres of origin of the Fifth nerve arise by two roots of which the anterior or motor can be traced to two masses of multipolar cells on the inner side and close to the gray tubercles of Rolando in the floor of the fourth ventricle. The posterior or sensory root arises directly from the tubercles of Rolando. The two roots pass through an oval opening in the dura mater on the superior border of the petrous portion of the temporal bone, above the internal auditory meatus. They then run between the bone and the dura to the apex of the petrous portion of the temporal bone, where the fibres of the sensory root form a large semi-lunar ganglion—the Gasserian. The motor root passes beneath the ganglion without having any connection with it and joins outside the cranium with one of the trunks derived from it.

339. Name the three branches of the Fifth nerve, and give function of each.

A. 1. Ophthalmic—sensory.

2. Superior Maxillary—sensory.

3. Inferior Maxillary—motor and sensory.

340. Name the branches of the Fifth nerve that supply the teeth.

A. Posterior and anterior dental branches of the superior maxillary supply the upper teeth. Dental and incisor branches of the inferior dental division of the inferior maxillary supply the lower teeth.

341. Give the function of the Pneumogastric.

- A.* 1. Motor influence to the pharynx, œsophagus, stomach, small intestine, larynx, trachea, bronchi and lung.
2. Sensory influence to same regions.
3. In part vaso motor to same regions.
4. Inhibitory influence to heart.
5. Inhibitory afferent impulses to vaso motor centre.
6. Excito secretory to salivary glands.
7. Excito motor in coughing, vomiting, etc.

342. How does the mind gain its knowledge and upon what is it based?

A. Through the medium of the nervous system the mind gains a knowledge of the existence of various parts of the body and of the external world. All knowledge is based upon sensations resulting from the stimulation of certain centres in the brain by impulses conveyed to them by afferent (sensory) nerves.

343. What is necessary to sensation?

A. 1. A peripheral end organ for the reception of impressions. 2. Nerve for conducting it. 3. Nerve centre for feeling or perceiving it.

344. How are sensations classed?

A. 1. As common. 2. As special.

345. Describe common sensations.

A. All which cannot be distinctly localized in any part of the body, as fatigue, discomfort, faintness, satiety, etc.

346. Describe special sensations.

A. From these we gain our knowledge of the external world by medium of organs which can be distinctly localized in some particular part of the body, as (1) touch by touch corpuscles, (2) smell by olfactory cells lining nostrils, (3) sight by eye, (4) hearing by ear, (5) taste by taste gobets of tongue, etc.

347. Describe touch.

A. An exaltation of common sensation which renders us conscious of the presence of a stimulus from the slightest to the most intense degree. It enables us to judge of the form and size of bodies, of their weight; gives us an idea of the temperature surrounding us.

348. What is pain?

A. The sensations of tactile sensibility, pressure or temperature, carried to an inordinate degree.

349. Describe the external ear.

A. That part of the ear external to the membrana tympani, made up of the pinna or auricle and the external auditory canal or meatus.

350. Describe the middle ear.

A. A cavity in the temporal bone communicating with the pharynx by a cylindriform canal, the Eustachian tube. The middle ear is separated from the external ear by the membrana tympani. The Eustachian tube and cavity of middle ear are lined with mucous membrane continuous with that lining pharynx. Its walls are osseous except where apertures in them are closed with membrane, as at fenestra rotunda and fenestra ovalis, by which it is separated from internal ear and membrana tympani, by which it is separated from external ear. It contains a chain of small bones extending from membrana tympani to fenestra ovalis.

351. Give functions of external ear, membrana tympani and chain of bones.

A. The external ear collects and reflects sound waves toward a central point, the external auditory canal. The canal carries the sound waves to the membrana tympani in which they set up sonorous vibrations, which in turn are communicated through chain of small bones to membrane covering fenestra ovalis.

352. Give function of Eustachian tubes.

A. They maintain an equilibrium between air in tympanum and external ear, thus preventing too great tension of membrana tympani. They render sound clear and supply tympanum with air.

353. Give function of internal ear.

A. It receives vibration conducted across middle ear by chain of bones to fenestra ovalis, and by column of air in tympanum to fenestra rotunda. The membranes covering these openings excite vibrations in perilymph, walls of membranous labyrinth and endolymph, which excite the terminal filaments of the auditory nerve by which they are conveyed to the brain.

354. To what instrument may the optical apparatus be compared.

A. To the camera used by photographers. The transparent media of eye correspond to lens of front part of camera. In the camera the images are thrown upon a ground glass screen at the back of box—interior of which is painted black. In the eye, the box is represented by eyeball with its choroidal pigment; the screen by the retina. In the camera, the screen is enabled to receive clear images of objects at different distances by an apparatus for focussing, corresponding to contrivance in eye described under head of Accommodation.

355. What is Accommodation?

A. The power of adapting the eye to vision at different distances, brought about by a varying shape of the crystalline lens. The nearer the object the more convex the anterior surface of the lens becomes. This increased convexity is produced by the contraction of the ciliary muscle. When the muscle relaxes the lens becomes less convex by virtue of the elasticity of its suspensory ligament.

356. Describe the action of the iris.

A. A musculo membranous curtain with a hole in the centre for the admission of light to the retina. The inner surface is covered with dark pigment, so all light is shut out except the rays admitted through pupil. Contraction of pupil occurs (1) On exposure of eye to bright light. (2) When the eye is focussed on near objects. (3) On local application of eserine.

Pupil Dilates: (1) In dim light. (2) Eye focussed for distant objects. (3) On local or internal administration of atropine and allies.

357. What is myopia?

A. Short sight where antero-posterior diameter of eye is greater than normal and image is thus focussed on point in front of retina.

358. What is astigmatism?

A. Greater curvature of eyeball in one meridian than in others.

359. What normal agent excites visual sensation in retina?

A. Light.

360. What do we mean by the sympathetic nervous system?

- A.*
1. A double chain of ganglia and fibres which extends from the cranium to the pelvis along each side of the vertebral column. Small ganglia in the cranium and connecting fibres.
 2. The cardiac, solar and hypogastric, aortic, spermatic and renal plexuses.
 3. Various ganglia and plexuses in the substance of many of the viscera.
 4. The ganglia on posterior roots of spinal nerves, on the glosso pharyngeal and vagus, and on sensory root of fifth. The sympathetic system connects freely with parts of itself and the cerebro spinal system.

361. Name the functions of efferent sympathetic nerve fibres.

- A.* They supply:
1. Muscles of vascular system with vaso motor fibres.
 2. Muscles of viscera with viscera motor and inhibitory fibres.
 3. Secretory gland cells with motor fibres.

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